**Inter-American Development Bank**
**Technical Cooperation Program**
**Japanese Trust Fund for Consultancy Services**

**TC/FUNDS BRIEF**

## I. GENERAL INFORMATION:

| | |
|---|---|
| Name of the T.C. Project: | Mathematical model for Tietê River in upper and medium basin influenced by the Metropolitan Area of São Paulo – Brazil. |
| Project Number: | TC-00-12 02-7 |
| Name of Fund: | Japanese Trust Fund for Consultancy Services |
| Beneficiary Country: | Brazil |
| Executing Agency: | Company of Environmental Technology (CETESB). |
| Amount to be financed by JCF | US$ 750,000 |
| Amount to be financed by local counterpart | US$ 330,000 |
| Estimated Total Amount | US$1,080,000 |
| Executing and Disbursement deadline: | Project execution: 15 months<br>Disbursement period: 20 months |
| People involved in preparation of TC | Antonio Carlos Rossin, team leader; Adriana Delgado; y Lidia Toledo (RE1/EN1). |

## II. BACKGROUND:

2.1 The São Paulo Metropolitan Area – SPMA, with a population of 16 million, consisting of the capital of the São Paulo and 37 other municipalities, encompassing an area of about 8,000 km2 (3% of the state). It produces 20% of Brazil's GDP. The state of São Paulo occupies 240.000 km2 (2,9% of Brazilian territory) and is home to 33 million people, making it the country's most populous state with 22% of total population. Thanks to its huge industrial apparatus, one of the Latin America's largest, the state accounts for over 30% of the country's gross domestic product.

2.2 The São Paulo Metropolitan Area sits on the northwest slope of Serra do Mar, a mountain formation of 700 meters above sea level and 40 Km from the coast, where mostly of the streams, that form the Tietê River, are located. This region is defined as Upper Tietê Basin. Tietê river flows through the metropolitan region, crossing São Paulo City, and flows from the coast to the inland (east to west) in the region defined as Medium and Lower Tietê Basin and reaches Paraná River, a tributary of Plata Watershed. This river has had a tremendous influence on São Paulo City land pattern occupation and today's industrial development set up within Metropolitan Area. Because it is located at the source of these gateways, the SPMA has to import more than 50% of the water from other basins. Tietê

River receives mostly of the wastewater generated in the Metropolitan Area, resulting in a very low dilution capacity.

2.3 Billings and Barra Bonita reservoirs were built in the early fifties to generate electricity to support the state's industrial development and emerging cities. Billings reservoir was set up near the coast but 700 meters high and receive water from Upper Tiête River basin through a pumping system, which also compromised other tributaries of the Tietê. From Billings the water is discharged in an estuarine river reaching the Atlantic Ocean and generating electricity to supply the Metropolitan Area needs. Part of the water, which is not pumped into Billings reservoir, flows naturally to the inland in another reservoir called Barra Bonita. In the late 90's, due to reduction in the neighboring sources of water, Billings reservoir became a possible source for drinking water and a water resources management conflicts were created.

2.4 SPMA's population and industry are placing heavy pressure on the state's water resources and electricity supply. The most economical sources of water has already been tapped and Companhia de Saneamento Básico do Estado de São Paulo (SABESP), responsible for water supply and sanitation in the SPMA, was forced to look for more distant and costlier options. For this reason SABESP's expansion plan has been slowed and the water supply to one million metropolitan region residents has had to be rationed.

2.5 The Tietê River, in the SPMA is completely anaerobic due to discharge of untreated industrial effluent and sewage and supports no fish life, emits foul odors most of the year, and serves as a sewage dump. It receives continual discharges of used water, at a rate of 40m3/s, representing 60% of the river's mean dry-weather flow, This pollution affects some 8 million people and it is the cause of the water quality deterioration in these two reservoirs.

2.6 São Paulo Government has developed different actions to recover environmental quality in Tietê river basin, mainly with the Bank support. The Bank has financed sewage collection and treatment projects in the SPMA in two phases: i) In phase I (US$400 million), two new wastewater treatment plants were built and other three were upgraded. More than 250.000 people were connected to the sewer system increasing to up 60% the coverage and up to 50% the percentage of treated effluents. In the phase II (US$200 million) and just beginning its implementation, more sewerage will be built to reach 80% of coverage and more sewage will be conducted to the existing wastewater treatment plans. The situation has improved, however more investments are still need for a future phase III, in which it is expected 90% of coverage and the treatment will reach 90% of the effluents of the area.

2.7 A simple mathematical model, using parameters such Biochemical Oxygen Demand (BOD) and Suspended Solids (SS), was used in Tietê phase I and II. This simple model was used to define the percentage of organics and solids to be

removed in the wastewater treatment plants, considering the dilution and assimilative capacity of the river and the use of it.

2.8 Besides this, CETESB – Environmental Control Agency for São Paulo state has implemented a industrial Pollution Control Plan to control the industrial wastewater discharge in São Paulo state rivers, with priority in the Tietê River Upper and Medium Basin. CETESB uses some methodological approaches, based in a simple mathematical model, to define the permissible level for pollutant discharges, considering the multiple uses of water. As it is known, there are economic implications when a certain grade of treatment for the industrial and domestic discharge is defined. To get more accurate levels of permission it is necessary to consider the amount of discharges the water river uses and the assimilative capacity of the river. This justifies the implementation of a more sophisticated and complex model.

2.9 With the operation of wastewater treatment plants implemented in phase I and II, it is expected an improvement in the Tietê River water quality, which could be used for many purposes. The conflicts will be worst since there are many interests involved: water supply, energy generation, recreation and irrigation. To decide the best investments for the future phase III it is necessary to develop a more sophisticated mathematical model (qualitative and quantitative) for Upper and Medium Tietê Basins. This model will be used to help the decision-maker and financial institutions to foreseen optimum application of its investments and efforts.

## III. OBJECTIVES

3.1 The objective of this Technical Cooperation is to design, construct and calibrate a modern mathematical model to simulate the water quality in the upper and medium Tietê river basin, including Billings and Barra Bonita reservoirs. This model will be used by different technical organizations in São Paulo State dealing with water resources such as CETESB, SABESP and the Tietê River Committee. This important planning tool will allow the evaluation of limnologic conditions in rivers and reservoirs and will help the decision makers to assume more appropriated management of the water resources in this region.

## IV. DESCRIPTION

4.1 The Technical Cooperation will include the following activities:

1. Selection and acquisition of a Mathematical Model;
2. Preliminary calibration and Scenarios simulation
3. Final calibration and project report
4. Personal training

**5.** Model disclosure

4.2 Selection and acquisition of a Mathematical Model consists in: i) identification, analysis and compatibilization of existing models; ii) selection of the most appropriated model for the upper and medium Tietê river basin, including Billings and Barra Bonita reservoirs; iii) implementation of the model in the whole integrated system; and iv) its installation in the computed system structure, working assessment, and analysis of results.

4.3 Preliminary calibration consists in: i) installation of data base from analysis of existing data and collection of new data; ii) definition of hidrologic situations and configuration loads; iii) execution of preliminar calibration; iv) assessment of main process that affect water quality; and v) scenarios simulation to define different situations and running the model for each scenario.

4.4 The final calibration and project report, will include: i) presentation of the model in its final version to CETESB's board, its adequacy to fulfill its institutional task, then present it to the major water resources management institutions, as well as the related watershed committees, which at best, represent the community; and ii) recommendations to use the model for the water resources management in Tietê river basin.

4.5 Personal training will consists in i) capacity building, while working with international and national consultants, resulting in training for the CETESB's technicians to run the model and update it and, ii) provide two workshops to discusses and implement the results.

4.6 Model disclosure, through seminars, making the model and it results well known to the scientific community and decision-makers in water resources management in São Paulo and other Brazilian states.

## V. RESULTS

As a result it is expected:

5.1 A sophisticated and complex model implemented and able to simulate conditions due to operational aspects in the Tietê river and in Billings and Barra Bonita reservoirs. The results from these simulation will help in the optimization of the multiple uses of the Tietê river water in the Upper and Medium Basins;

5.2 Technicians and decisions makers from CETESB, SABESP, trained in operation and maintenance of this model; and

5.3 The scientific community and decision-makers in water resources management, informed about the model;

## VI. EXECUTING AGENCY AND TIME

6.1 This project will be executed by Companhia de Tecnologia de Saneamento Ambiental (CETESB), the Environmental Control Agency of the Secretary of Environment in São Paulo State. CETESB is the organization responsible for applying of preventive and corrective measures for pollution control and environmental preservation. CETESB has nine automatic monitoring stations in the Tietê River and also develop a manual monitoring program collecting information related to water quality thought out the Tietê river basin.

6.2 The project will last 15 months. The Fund will finance the contracting of consultant firm that provides Japanese and local consulting services, a mathematical model and organize seminars and workshops. Local technicians, administrative services and logistical support will be financed as a counterpart contribution.

## VII. ENVIRONMENTAL AND SOCIAL ASPECTS

7.1 The environmental indirect impact of this operation will be positive. The model developed will be used to manage the High and Medium Tietê Basin and will help the pollution control of these water bodies. It is not foreseen any negative environmental and social direct impact.

## VIII. JUSTIFICATION

8.1 The strategy of the Bank in Brazil emphasizes: i) reform and Modernization of the public sector at federal, state and municipal level; ii) improved competitiveness and market access by supporting the financial system, small and medium size enterprises, rehabilitation of basic infrastructure, tourism development, and regional integration; iii) reduction of social inequality and poverty, giving priority to education, health and seeking out association with community and civil society; and iv) attending problems of environment and natural resources management.

8.2 The proposed project is consistent with Bank’s strategy because it will improve the public sector capacity to the management of water resources, especially in a very populated area where the water is scarce and the pollution problems are huge.

8.3 Any further investment in this area, related to water resources will need a more structured and complex mathematical model to manage the quality and quantity of water and its diversified use, in this complex environment.

## IX. BUDGET

9.1 The total cost of the operation is estimated at US$ 1.080.000, distributed as shown in Table 1. The amount to be financed by the Japanese Trust Fund for Consultancy Services is US$ 750.000

## I. RESPONSIBILITY IN THE BANK:

**Technical Responsibility:** Antonio Rossin (RE1/EN1). Tel 1 202 623 1686. Fax 1 202 623 1417. Email: antonioro@iadb.org.

## II. APPROVAL:

**Approved: _____** **_____**

**Date**